

# GENERATING OPTIONS FOR ROADSPACE ALLOCATION IN BUSY URBAN ROADS

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## 1. INTRODUCTION

Urban roads and streets have different uses: movement by different modes of transport (public or private, motorised or non-motorised), freight distribution, vehicle parking, waiting for buses, relaxing, socializing, provision of green space, surface water management, and others. Currently, urban roads and streets are under great pressure due to the need to accommodate increased mobility levels and 'just in time' deliveries and servicing, at the same time that governments are putting increased focus on developing attractive spaces to support active modes of transport and encouraging place activities, all within fixed road widths.

Despite the competing interests involved, decisions to reallocate roadspace are usually made on an ad-hoc political basis. In particular, the option generation stage tends to be omitted. The usual procedure in urban road (re)design processes is to present the public with a small set of possible options, for consultation. These options are not the result of a systematic process.

To fill this gap, we developed two web-based tools for the generation of options for roadspace reallocation (currently at <https://more.traffwebdev.uk>, from 2022 at <https://www.roadspace.eu>). The tools assist planners to explore feasible solutions that consider the needs of all road uses and a range of economic, social, and environmental objectives. The *Policy Interventions* tool generates options for the static or time-based reallocation of roadspace, selected from a library of 210 types of interventions. The *Road Designs* tool generates detailed roadspace allocation designs, in cross section, combining different design elements.

The tools were created by the authors, with feedback from associations representing pedestrians, cyclists, and public transport users and from planners in five European cities (London, Lisbon, Budapest, Malmo, and Constanta). The tools were validated in real-world scenarios in the five cities and are now available for wider use in other cities.

## 2. POLICY INTERVENTIONS TOOL

The Policy Interventions tool generates options for broad types of interventions on urban roads and streets, including interventions that: 1) change the allocation of space among users, permanently: 2) change the allocation of space only at some times (e.g. evenings, weekends, holidays): 3) change the allocation of space dynamically, based on demand for

different uses at each time; 4) do not reallocate space among users but change the (physical or legal) conditions under which the road can be used. The tool contains 210 possible options, collected from the literature.

The figures below show the two inputs of the tool: the priorities assigned to each type of road use (Figure 1) and the objectives the intervention should achieve (Figure 2). There are three possible levels of priority to road uses: "0" (the conditions for that type of road use can deteriorate, if required to improve conditions for other road uses), "1", (the conditions should not deteriorate), or "2" (the conditions should improve). A maximum of five objectives can be chosen.

The list of possible road uses and objectives were compiled based on a review of the literature and discussions with project partners, including the five cities and associations representing pedestrians, cyclists, and public transport operators.

The list of road uses comprises different ways in which the road can be used by 15 types of users, both of non-motorised and modes of transport. This includes: pedestrians, pedestrians with restricted mobility, cyclists, micromobility users (scooters, skates, etc.), bus drivers, bus passengers, rail/metro/bus passengers, car drivers, car share users, motorcyclists, taxi drivers and passengers (including ride-hailing vehicles), and users of goods, emergency, and service vehicles. As example, pedestrians can use the road in five possible ways: walking, crossing the road, strolling, sitting on benches or other street furniture or sitting on cafés or other outdoor commercial spaces.

The list of objective covers objectives related to the movement and the 'place' functions of the road, operational aspects, and wider objectives (i.e. those that related to the benefits of costs of using the road), split into economic, social, and environmental objectives.

**Figure 1. Policy Interventions tool input: Road use priorities**

**PRIORITIES**  
 Choose from the green dropdown menus the degree of priority of each type of road user or road use

0 Can be worse off than now, if needed  
 1 Should not be worse off than now Choose a maximum of 3 road uses with level 1  
 2 Should be better off than now Choose a maximum of 3 road uses with level 2

Road user	Road use		Road user	Road use	
<b>Pedestrians</b>	Walk	0	<b>Bus drivers</b>	Move	0
	Cross the road	0		Stop	0
	Stroll	0	<b>Bus Passengers</b>	Interchange	0
	Sit (street furniture)	0		Wait	0
	Sit (outdoor cafe)	0	<b>Rail/metro/bus passengers</b>	Interchange	0
<b>Pedestrians with restricted mobility</b>	Walk	0	<b>Car drivers</b>	Move	0
	Cross the road	0	Park	0	
<b>Cyclists</b>	Move	0	Stop	0	
	Park	0	<b>Car share users</b>	Move	0
	Rent (dock)	0	<b>Motorcyclists</b>	Move	0
	Rent (dockless)	0	<b>Taxi drivers (inc. ride-hailing)</b>	Wait	0
<b>Micromobility users (scooters, skates, etc.)</b>	Move	0	<b>Taxi passengers (inc. ride-hailing)</b>	Wait	0
			<b>Goods vehicles</b>	Move	0
			Stop	0	
			<b>Emergency vehicles</b>	Move	0
			<b>Service vehicles</b>	Move	0

## Figure 2. Policy Interventions tool input: Objectives

### OBJECTIVES

Fill the checkboxes of the objectives the intervention aims to achieve

Choose only the main objectives (Maximum of 5)

#### Movement

- Increase number of trips
- Reduce travel time
- Increase travel time reliability
- Reduce congestion
- Improve trip quality
- Achieve a more sustainable modal split

#### Place

- Facilitate place activities (e.g. people sitting)
- Facilitate kerbside activities
- Improve access to local buildings

#### Road operation

- Improve resilience (to weather conditions)
- Increase flexibility (to different road uses)

#### Wider objectives: economic

- Reduce costs of transport
- Promote local economy

#### Wider objectives: social

- Improve traffic safety
- Reduce community severance
- Increase personal security
- Promote physical activity/health
- Promote social interaction
- Promote social inclusion
- Increase wellbeing

#### Wider objectives: environmental

- Increase green space
- Improve air quality
- Reduce noise
- Improve visual environment
- Protect soil/water and reduce flood risk
- Improve local climate
- Reduce energy consumption
- Improve regional/global environment


The tool returns a list of all interventions that fulfil the criteria specified in the inputs regarding road uses and objectives. This uses a query to the interventions database, which includes fields describing the likely effect of the interventions on road uses and objectives as positive, uncertain/neutral, or negative. This information was filled based, where possible, on empirical evidence collected from the literature. When evidence was not available, the likely effect was assigned based on the theory regarding the likely chain of effects of intervention, i.e. changes in the behaviour of all road users and possible consequences of those changes. The information was assigned by the authors and reviewed by project partners.

The tool shows, for each of the policies presented in the results list, four pages of information. The first page is a general description of the intervention, general design guidelines, and types of areas and roads where the intervention can be applied. Figure 3 shows an example of this page (for the "Add or widen middle strip" intervention). The second page (Figure 4) lists examples of the intervention around the world and the main effects identified in the literature, with references to the respective studies. The other two pages (Figure 5 and Figure 6) list the likely effect on all road uses and objectives.

**Figure 3. Policy Interventions tool output: Example of *Description* page**

— Add or widen median strip

Description   Examples and evidence   Effect on road uses   Effect on policy objectives



**Type of policy:** Space allocation

Also known as central reservation. Space between traffic lanes in different directions. It can be painted, raised with kerbs, or planted. Physical barriers (e.g. guardrailings) may be added, or kept, if already existent, to separate vehicles.

If the median has no physical barriers, it allows vehicles to pass cyclists or slower vehicles; emergency vehicles to cross over into the opposite lane; and pedestrians to stop and cross in two stages (at crossing facilities or informal crossings)

If the median is raised, wide enough, and has few gaps, it also allows pedestrians to walk along the road. Alternatively, it can provide space for place activities (e.g. seating areas), car parking, bicycle parking, or street furniture (e.g. lighting).

Median strips can be green spaces (e.g. trees, swales, grassed strips). If wide, they can be used as a cycle track or as a corridor for trams, light railway systems, or buses. Underground rivers can also be restored to run at-  
(...)

**Figure 4. Policy Interventions tool output: Example of *Examples and evidence* page**

— Add or widen median strip

Description   Examples and evidence   Effect on road uses   Effect on policy objectives

**Examples**

- Restricted-access roads (e.g. motorways) and multilane roads usually have wide medians, with barriers at the carriageway edges, and sometimes a grassed strip in the middle.
- In 2013, a long and wide median strip was added to Avenida 9 de Julio in Buenos Aires (one of the widest urban streets in the world), with a busway, greenery, and pedestrian paths.
- The space between Carretera 7 and Calle 32 in central Bogota is a wide median accommodating a cycle lane, several clear paths for pedestrians, benches, a planted strip, and a station entrance.

**Evidence**

- The redesign of a 4-lane road in New Jersey, adding a raised median, reduced pedestrian exposure risk and increased driver predictability, and little effect on traffic speed and volume.  
**See:** King et al 2003 Pedestrian safety through a raised median and redesigned intersections. Transportation Research Record 1828, p56-66.
- A study in 24 cities in California found that the proportion of streets with (raised or painted) medians is associated with only small changes in the walking and cycling modal share.  
**See:** Marshall and Garrick 2010 Effect of street network design on walking and biking. Transportation Research Record 2198, 103-115.
- Adding a median strip to a road has an estimated monetary benefit for pedestrians crossing the road of £1.08 for each walking trip.  
**See:** Ancaes and Jones 2018 A stated preference model to value reductions in community severance caused by roads. Transport Policy 64, 10-19.

**Figure 5. Policy Interventions tool output: Example of *Effect on road uses* page**

— Add or widen median strip

Description   Examples and evidence   Effect on road uses   Effect on policy objectives

**Likely impact of intervention on road uses**

Compared to: Do not add or widen median strip

Road user	Road use	Impact	Reason
<b>Pedestrians</b>	Walk	+	Median strip can be walkable
	Cross the road	+	Can stop in middle of road when crossing. Lower traffic speed
	Stroll	+	Median strip can be walkable
	Sit (street furniture) Sit (outdoor cafe)	+	Median strip can accommodate seating area Median strip can accommodate tables
<b>Pedestrians with restricted mobility</b>	Walk	+	Median strip can be walkable
	Cross the road	+	Can stop in middle of road when crossing. Lower traffic speed
<b>Cyclists</b>	Move	+	Fewer unsafe crossing movements by pedestrians
	Park	+	Median strip can accommodate bicycle parking
	Rent (dock)	+	Median strip can accommodate docks
	Rent (dockless)	+	Median strip can accommodate rental bicycles

(...)

**Figure 6. Policy Interventions tool output: Example of *Effect on policy objectives* page**

— Add or widen median strip

Description   Examples and evidence   **Effect on road uses**   Effect on policy objectives

**Likely impact of policy intervention on objectives**

Compared to: Do not add or widen median strip

Objective	Impact	Reason
<b>Movement</b>		
Increase number of trips	+	Encourages more walking. Easier to cross the road
Reduce travel time	-	Probably delays to motorised modes
Increase travel time reliability	-	More probability of queues
Reduce congestion	-	More probability of recurrent congestion, less space
Improve trip quality	+	Easier to cross for pedestrians. Safer for cars
Achieve a more sustainable modal split	o	No evidence on impact on mode choice
<b>Place</b>		
Facilitate place activities (e.g. people sitting)	+	Space can be used for place activities
Facilitate kerbside activities	-	Space probably taken from kerbside area
Improve access to local buildings	-	More difficult to access the opposite side of road
<b>Road operation</b>		
Improve resilience (to weather conditions)	+	Fewer motorised vehicles. Scope to add greenery
Increase flexibility (to different road uses)	-	Fixed element of infrastructure
<b>Wider objectives: economic</b>		
Reduce costs of transport	+	Requires only regular maintenance

(...)

The Policy Interventions tool fills a gap in decision-support methods available to practitioners, as the information of possible interventions is currently scattered across studies that focus on specific street uses or objectives. The new tool organizes the existing information, and classifies it consistently (using the same fields for all the interventions in the database). This is useful for planners as it provides a clear comparison between the advantages and disadvantages of each type of intervention.

**3. ROAD DESIGNS TOOL**

The Road Designs tool generates detailed options for roadspace allocation options, represented as cross-sectional designs. These are combinations of nine types of design elements: space for walking, space for place activities (e.g. stalls, benches, outdoor cafés), green area, lane for general traffic, bus lane, space for cycling (cycle lane or cycle track), mixed bus and cycle lane, space for parking and loading, and tram lines.

The possible widths of each element were assigned in the tool database considering information from design guidelines in the five partner cities. Each type of element can assume two possible sizes (e.g. minimum standards or wider) and be placed in 13 different positions across the road (3 in the left-side footway, 2 in the left-side carriageway, 3 in the middle strip, 2 in the right-side carriageway and 3 in the right-side footway). The width of some elements depends on their position across the road and on the type of design elements that are placed next to them. For example, cycle lanes or tracks are wider when they are in the middle strips, surrounded by lanes of moving traffic.

The tool contains 30,300 possible options. These are all combinations of the nine types of design elements (which can assume different widths) that fit in roads with widths between 15 and 35 metres. Unfeasible designs were excluded. For example, designs where the lanes for the movement of cars or buses are at the edge of the road, without footways separating them from buildings.

The figures below show the two inputs of the tool: the width currently allocated to each type of design element (Figure 7) and the desired priorities of each design element (Figure 8). There are three possible levels of priority to design elements: "0" (Not relevant - no space provided), "1" (Relevant, but not priority - will have some space but not more than now), or "2" (Relevant and priority - will have at least the same space but more, if possible).

**Figure 7. Example of Road Designs tool input: current situation**

**CURRENT SITUATION**  
 Indicate in the green boxes the road width currently allocated to each design element (counting both sides of the road and the median strip)

\* Leave field as 0 if the road does not have that design element  
 \* Insert values in metres  
 \* The total road width should be more than 15m and less than 35m

Space for walking	6
Space for place activities (stalls, benches, outdoor cafés, etc.)	0
Green area	0
Lane for general traffic	12
Bus lane	0
Space for cycling (cycle lane or cycle track)	0
Mixed bus and cycle lane	0
Space for parking and loading	0
Tram lines	0
<b>Total width:</b>	<b>18 metres</b>

**Figure 8. Example of Road Designs tool input: priorities**

**PRIORITIES**  
 Choose from the green dropdown menus the degree of priority of each design element

0: Not relevant in this road (no space provided)  
 1: Relevant, but not priority (will have some space but not more than now)  
 2: Relevant and priority (will have at least the same space but more, if possible)

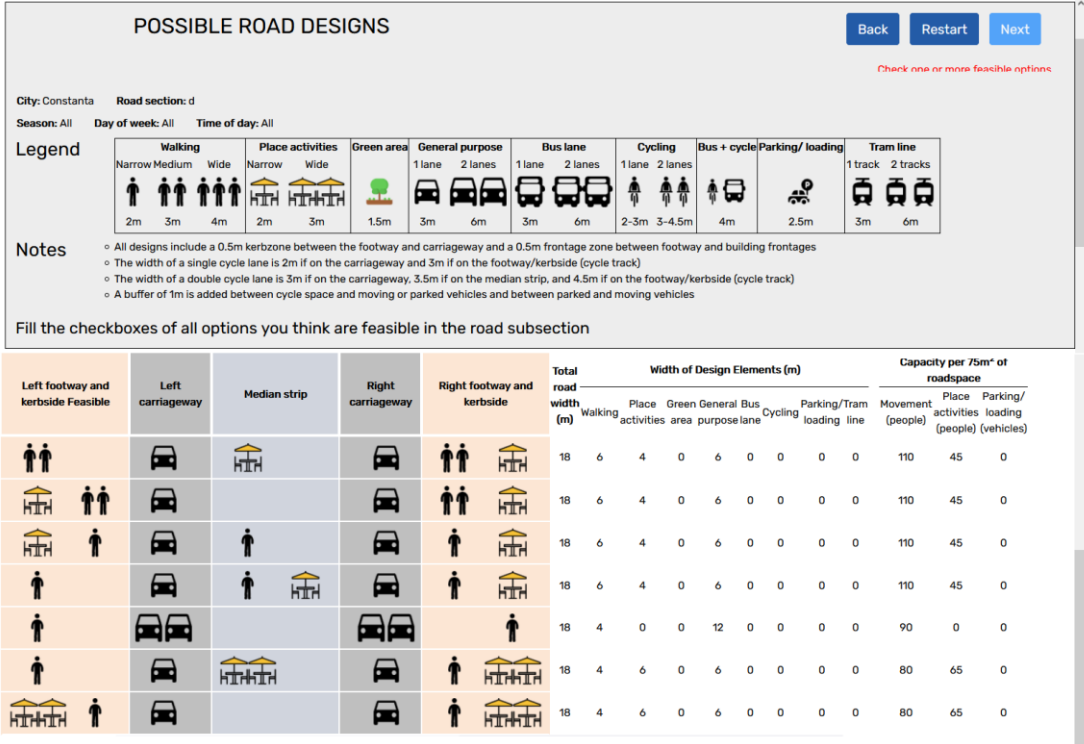
The tool will show designs with these widths:  
 These values are calculated automatically

		Minimum	Maximum	
Space for walking	1	4	6	
Space for place activities (stalls, benches, outdoor cafés, etc.)	2	0	6	
Green area	0	0	0	No road designs will include this element
Lanes for general traffic	1	3	12	
Bus lane	0	0	0	No road designs will include this element
Space for cycling (cycle lane/cycle track)	0	0	0	No road designs will include this element
Space for parking and loading	0	0	0	No road designs will include this element
Tram lines	0	0	0	No road designs will include this element

The tool returns a list of all designs (i.e. combinations of design elements) that fulfil the priorities specified in the inputs and fit in the available road width. Figure 9 shows an example of the tool output (for the inputs specified in the previous figures). In this case, the tool returns seven possible options. The design elements are identified by icons. Each design includes the total road width assigned to each type of design element, and estimates of the

road capacity (per 75m<sup>2</sup> of street space) assigned to movement (by any mode of transport), to place activities and to parking and loading.

**Figure 9. Example of Road Designs tool output**




The Road Designs tool fills a gap in existing methods by considering the full range of combinations of design elements that can be feasibly accommodated in a road. Some of these combinations may be less obvious and thus may not usually be considered by planners. However, these options may not only be feasible but also be aligned with the priorities that governments feel that need to be assigned to some road uses.

**4. CONCLUSIONS**

The two tools provide planners with an objective and systematic means to generate a comprehensive set of options for redesigning urban roads and reallocating space from one type of use to another. The set of options generated balance different user needs and policy objectives, taking into account existing constraints. This existence of this balance in the option generation stage contributes to the political feasibility and public acceptance of the options in the final decision stage. The tools are also openly available to the general public, increasing the transparency of the process.

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